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European Pine Sawfly

by Louis F. Wilson[1]

The European pine sawfly, *Neodiprion sertifer* (Geoff.), an introduced insect, was first recorded in North America in 1925 in New Jersey. Its present known distribution in the United States includes most of the Northern States from New England to Michigan, southwest to Iowa, and as far south as southern Illinois and southern Ohio. It is also common in southwestern Ontario in Canada. It is widely distributed overseas—in Sweden, Finland, Russia, Germany, Austria, Hungary, Czechoslovakia, and Japan.

Hosts

In North America this sawfly severely defoliates Scotch pine (*Pinus sylvestris* L.), red pine (*P. resinosa* Ait.), jack pine (*P. banksiana* Lamb.), Japanese red pine (*P. densiflora* Sieb. and Zucc.), Table-Mountain pine (*P. pungens* Lamb.), and mugho pine (*P. mugo* Turra). Some feeding occurs on eastern white pine (*P. strobus* L.), Austrian pine (*P. nigra* Arnold), ponderosa pine (*P. ponderosa* Laws.), shortleaf pine (*P. echinata* Mill), and pitch pine (*P. rigida* Mill), if any of these species grow with the favored hosts. Hosts of all sizes are attacked.

Females will lay eggs on all these pines. Pitch pine needles containing eggs die and fall, and the eggs fail to hatch. Eggs are found less often on Austrian pine—perhaps because the needles are too hard for egg laying. Eggs are seldom found on white pine in the field.

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Figure 1.—Damaged Scotch pine branch shows dried, skeletonized needles and defoliation. The young larvae are visible on the needles.

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Injury

After hatching and until the first molt, the larvae skeletonize the needles, starting with those on which the eggs were laid. These strawlike needle remains (fig. 1 appearing on page 1) die and then drop from the host about 2 weeks later. Older larvae consume the entire needle down to the needle sheath. Also, during the last half of the feeding period, the larvae consume a small amount of bark from the older branches and kill or malform some of the new shoots.

Since emergence begins early in the spring before the new growth foliage appears, only the old foliage is eaten. At the time of cocooning, the needles on the new shoots are

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Figure 2.—Upper parts of a Scotch pine just prior to larvae cocooning. Notice the nearly complete removal of the old foliage and partial growth of the new.

about half grown (fig. 2). The larvae do not defoliate the new shoots. Because new needles are developing while old needles are being devoured, the tree is never completely bare of foliage. For this reason, sawfly feeding seldom causes tree mortality.

Bark feeding kills a few twigs but causes no significant injury. Single and repeated defoliations, however, cause losses in height growth. For example, in an experiment performed in Michigan, a single defoliation by 10 larval colonies reduced height growth of a 5-foot Scotch pine by 14 percent. Under the same conditions 25 colonies reduced height growth by about 23 percent, and 50 colonies caused 37-percent reduction. Seldom does a stand of 5-foot trees average more than 25 larval colonies per tree, so the average loss rarely exceeds 23 percent. However, greater growth losses will occur on shorter trees with fewer colonies, and repeated heavy defoliations in subsequent years will produce even more pronounced growth losses. Diameter growth is similarly reduced.

In the few places where tree mortality has occurred, only the smallest trees, singly or in very small groups, succumbed. Though extensive mortality is seldom a threat, repeated defoliation weakens the trees, increasing their susceptibility to attack from secondary insects and diseases. The probability of losses from secondary pests should be included in control considerations.

Description

The elongate-oval egg is pale yellow to nearly white. Its average size is 1.8 mm. long by 0.3 mm. wide (fig. 3).

The newly hatched larva is about 3.5 mm. long with a white head that soon becomes black. Its body is a uniform light gray green, and the thoracic legs are black. When fully grown, the larva is ¾ to 1 inch long (fig. 4). The body has several longitudinal stripes of varying green shades. The dorsal surface is marked with a narrow line, flanked by a broader dark band on either side. Each side of the body has two very dark bands, separated by a thin, light stripe. The dark bands may be nearly black and tend to break up into spots in some areas of the body. An additional dark spot is present in the upper area on each side of the last abdominal segment. The eight pairs of abdominal prolegs and the underside of the abdomen are light yellowish green.

The fresh prepupa resembles the full-grown larva in size and shape. It is marked by a breaking up of the longitudinal stripes. The remaining bands are less distinct, and the head capsule is brown.

The cocoon is light to dark golden brown, tough, and finely textured (fig. 5). It is cylindrical with bluntly rounded ends. Length varies from 8 to 10 mm., the male cocoon being smaller than the female.

The adult length varies from 7 to 9 mm. The male, which is smaller than the female, has a black head and thorax; the abdomen is black above and reddish brown beneath. Its legs are also reddish brown, and its antennae are feathery. The female has a yellowish-brown body. Its eyes, part of the antennae, and thorax are black. Both the male and female are flylike in general appearance but have four shiny transparent wings.

Life History and Habits

The European pine sawfly completes one life cycle per year. It overwinters as a well-developed egg embryo. Depending upon locality and climate, hatching begins in mid-April to early May and continues for about 2 weeks. The larvae feed gregariously, and remain in colonies throughout their development

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Figure 3.—Cluster of European pine sawfly eggs in red pine needles.

(fig. 6). As the colony feeds, it moves down a branch and onto new branches. If the food supply on the entire tree is exhausted, the larvae crawl to new hosts. Newly developing needles are not fed upon. The 4- to 6-week feeding period ends sometime between early June and mid-July, depending on locality.

During development, the male larva sheds its skin four times, the female five. The last molt produces active prepupae that do not feed. These prepupae search for sites to spin their cocoons. Cocoons

commonly are spun in the duff beneath the host tree, but some may be found in protected locations on a tree beneath male flowers or in the webbing and excrement of other insects.

The prepupae lie in their cocoons in a resting state, called diapause, until late August or early September. Then most of them pupate, although some remain in the cocoon as prepupae for an extra year or two before pupation. Adults emerge between early September and late autumn. After mating, the females deposit their eggs singly in slits that they saw in the edge of the current year's needles. Six to eight eggs are usually laid on each needle, but the number may vary from 1 to 19 depending on host species and needle length. Eggs are deposited in a cluster of needles near the end of a branch. An average cluster contains about 80 eggs, but clusters may occasionally contain over 200. Each female may lay all her eggs on one shoot or on several shoots.

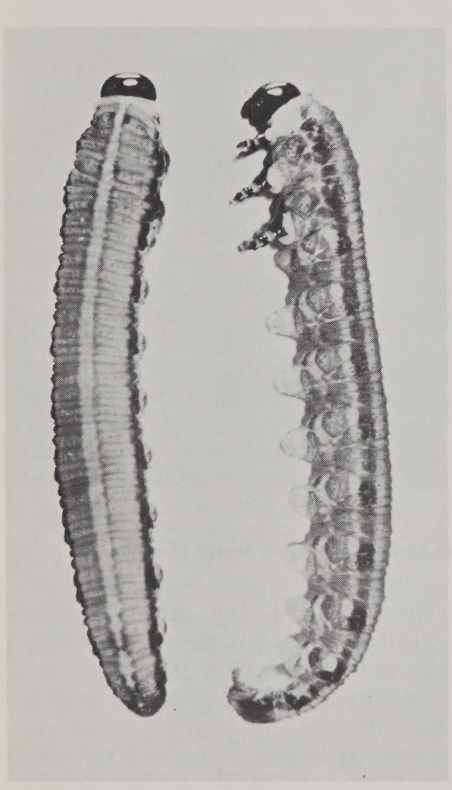

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Figure 4.—Top and side views of the larva of the European pine sawfly.

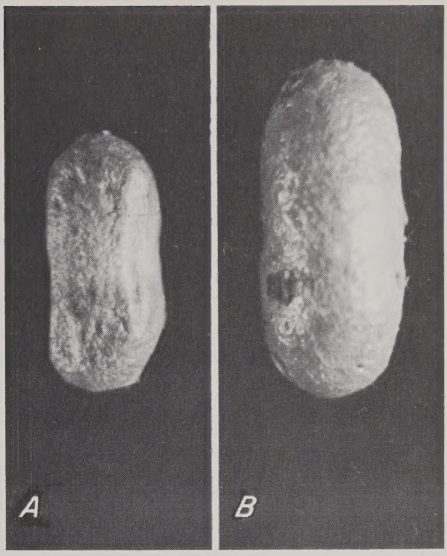

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Figure 5.—Cocoons of the European pine sawfly: *A*, Male; *B*, female.

Natural Control

Various degrees of larval or pupal control have been attributed to natural agents, such as low temperatures, parasites, predaceous insects, small mammals, birds, bacteria, fungi, and a polyhedral virus. Occasionally, when populations increase faster than the available food supply, starvation acts as a control.

Several species of parasites of this sawfly have been introduced into North America from Europe. These, like most of the other agents above, have not given adequate control. Only the polyhedral virus, which is a specific and virulent disease, has been used effectively as a control agent.

The virus was tested in Sweden with excellent results. It proved equally virulent in North America.

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Figure 6.—A larval colony of the European pine sawfly feeding on Scotch pine needles.

Healthy larvae become infected when they consume virus-covered foliage or when they ingest polyhedra released from remains of disease-killed larvae. Rain hastens the spread of infection on each tree, and birds, scavengers, parasites, and other agents are thought to help spread the disease between trees and between stands. First mortality occurs about 4 days after contact with the virus, but heavy mortality seldom occurs before 10 days.

Larvae infected lightly or late in their development often spin cocoons. Infected females that survive may transmit the virus through their eggs. This causes early larval mortality in the following generation. The virus is carried over year

after year in this manner, since it does not overwinter on the foliage. The disease persists for longer periods in stands of trees over 8 feet tall than in stands of smaller trees.

Control of this insect is rarely necessary and seldom recommended, except when Christmas tree plantings and ornamental trees are to be protected, or when trees are endangered by secondary pests. If control is desired, however, the polyhedral virus disease will give excellent results and is perfectly safe. Although complete larval mortality is possible, a reduction of about 90 percent is desirable for forest protection. In this way, the disease may be maintained in the population and spread naturally in subsequent years. By this means populations are thought to be controlled for at least 5 years. Christmas tree growers would probably prefer 100-percent mortality because light defoliation will lower the value of their product.

The virus may be obtained from certain public agencies, but individuals can make their own virus suspensions directly from the diseased larvae. Freshly killed diseased larvae are soft and black and are found hanging head downward from the foliage. At this stage the larvae are virtually sacs full of virus particles. These are more suitable than diseased larvae that have been dead long enough to become hard and "mummified." The most productive time to collect them is late in the feeding period when the healthy larvae are nearly full grown.

A stock solution can be made from almost any number of larvae, depending upon the area to be covered; for example, 1 pint from 100 medium-to-large larvae. Where the disease is present, the larvae are not difficult to collect because entire colonies, rather than individuals, are killed. The dead larvae are placed in a pint jar filled with chlorine-free water (distilled or rainwater). They are allowed to disintegrate in the water until the following spring or until the polyhedral bodies have settled out. The solution is filtered through fine material, such as loose-cotton cloth or silk-stocking material, to remove the larval debris. The pint of stock solution is then ready for use in various dilutions, depending upon the mode of application.

The virus should be applied shortly after the sawfly larvae hatch from the eggs. Best results are obtained if spraying is done in early morning or late evening when the wind is less intense and the humidity is higher.

An aerial application is the most economical method if large areas or inaccessible tracts of forest are to be sprayed. To obtain about a 90-percent population reduction, the spray mixture should contain a quantity of polyhedral virus equivalent to about 15 diseased larvae per gallon of solution. Add one-third of a cup of the stock solution mentioned above, well shaken, to each gallon of water. To improve spreading and retention of the virus spray, add one-eighth of a cup of Triton X-100 and 2 cups of white oil to each gallon of spray solution. As an alternative, add 5 level teaspoons of powdered milk to each gallon of solution. Apply the spray solution at the rate of 2 gallons per acre.

Hydraulic or knapsack sprayers can be used for spraying a few trees or small stands of trees. The spray solution consists of about 1 teaspoon of the stock solution to 6 gallons of water. Add 5 level teaspoons of powdered milk to each gallon of spray solution. Drench foliage thoroughly on all sides of the tree. The quantity of spray solution needed depends upon the number and size of the trees in the stand.

Christmas tree growers, using knapsack or hydraulic sprayers, should prepare spray solutions with

2 or 3 teaspoons of stock solution per 6 gallons of water to obtain maximum larval mortality. The virus must be applied as soon as possible after the sawfly larvae hatch to prevent the small amount of defoliation that normally occurs before significant larval mortality.

Chemical Control

Chemicals may be applied almost any time during the larval period, but are most effective a few days after hatching.

The sawfly larvae are susceptible to several insecticides. DDT is very effective and economical. With knapsack sprayer or hydraulic sprayer, use 2 teaspoons of liquid DDT (25-percent emulsion concentrate) in a gallon of water. If the spray liquid is to be agitated so that the active ingredient will not settle out, use 3 level tablespoons of 50-percent wettable powder DDT per gallon of water instead. Drench foliage on all sides.

For a mist blower application, use 8 teaspoons of liquid DDT (25-percent emulsion concentrate) per gallon of water.

Infestations over large areas or in inaccessible areas are controlled best by aerial application. One formulation consists of 1 pound of technical grade DDT (12½-percent powder) dissolved in 1¼ quarts of solvent and added to 2¾ quarts of No. 2 fuel oil. Another formulation consists of equal parts of 25-percent DDT concentrate and No. 2 fuel oil. Apply either formulation at the rate of 1 gallon per acre.

Caution: DDT is poisonous to man and animals. Follow the directions and heed all precautions on the container label. Handle it with care. Special caution is required when using concentrates: wear rubber gloves and avoid contact with eyes, nose, and mouth. After mixing chemicals or spraying, wash exposed body surfaces with soap and water. Change clothing if spray has been spilled on it.

Do not apply DDT where there is danger of deposit on fruits or vegetables or on plants grazed by cattle. Avoid overdosing. Don't apply near streams, ponds, and lakes.

Store chemicals in plainly labeled containers out of reach of children. Destroy used containers.

The virus disease is not harmful to organisms other than the European pine sawfly and requires no special precautions.

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